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Filtration of Maple Sirup

C. O. Willits, H. A. Frank,
and J. C. Underwood

THE PRODUCTION of sirup by atmospheric evaporation of maple sap is exclusively a farm operation. Most maple sirups, as they leave the evaporator, contain varying amounts of suspended matter which cause the sirups to have a cloudy appearance. These suspended solids are principally the calcium and magnesium salts of malic and other organic acids. The extent of this cloudiness influences the price paid for sirups. Further, sirups intended for table use, sold directly or indirectly to the consumer, must be essentially free of cloud to meet state and federal requirements. Since the highest prices are paid for those sirups having a minimum of cloud, and since table sirups must be essentially free of cloud, it is of great economic importance to the maple sirup producer that he clarify his sirups and that he employ the most efficient method available.

Clarification is occasionally done by sedimentation and, more commonly, by filtration. The sedimentation method has a number of disadvantages. Among these are: it is ineffective when the cloud consists of extremely finely-suspended particles of sugar sand; it requires a relatively long period of time; and, during the sedimentation period, the sirup cools and must be reheated for sterilization prior to packaging. This reheating is usually accompanied by the formation of additional cloud and a darkening of the sirup.

Clarification is best accomplished by pressure or vacuum filtration which permits the use of filter aids. However, the quantity of sirup filtered at any one farm where the sirup is made is, with few exceptions, not large enough to warrant investment in pressure or vacuum filtration equipment. Therefore, most sirups are filtered by gravity, requiring only inexpensive equipment. All that is required is a relatively thick but porous filter bed that will allow rapid flow of the sirup and which will remove the suspended sugar sand. Wool felt provided a filter that met these requirements. Originally these felt filters were made in the form of a cone-shaped bag which permitted suspension of the filter over a milk can or other container. Because of the mechanical strength of the felt and the shape of the bag, additional external supports were unnecessary. The disadvantages of the bags are that they are of a fixed size (capacity) and, unless the sirup is kept constantly at maximum depth, a large portion of the filtering surface is not utilized. In addition, there is also a loss of filtering surface caused by deposition of a heavy layer of sugar sand in the apex of the cone.

To overcome these objections to the cone-shaped felt filters, flat felt filters have recently been introduced. The felt can be obtained in large sheets which can be cut to any desired size. With the flat filter, the entire filter surface is utilized continuously and does not require that the sirup be maintained at a constant depth. Distribution of the sugar sand over the entire surface area results in a thinner layer so that the filters can be used for longer periods before cleaning becomes necessary.

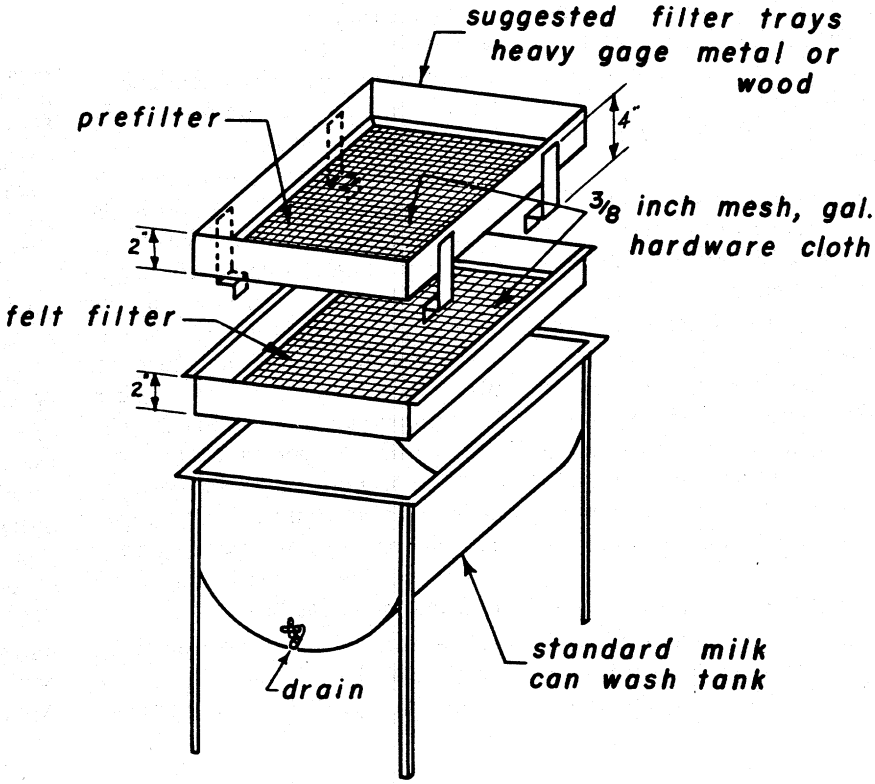

FIG. 1.—Sirup filter.

THE AUTHORS are members of the Eastern Regional Research Laboratory, Eastern Utilization Research and Development Division, Agricultural Research Service, U. S. Dept. Agric., Philadelphia, Pa.

The felt sheet can be supported in a shallow basket of hardware cloth with 2-inch walls, as shown in Figure 1. The felt is cut at least 4 inches larger than the bottom of the basket and the edges turned up 2 inches to form a shallow tray. The felt can be used two or three times longer between cleanings if the sirup is first run through a prefilter to remove a large percentage of the coarser particles of sugar sand. The prefilter should be moderately retentive and still permit a free flow of the liquid through it. Rayon press cloth makes an excellent prefilter material since it meets these requirements. The prefilter is mounted above the felt and is supported on a wire-screen basket the same size as that used for the felt. The filter racks can be built in multiple units over a common tank. As one filter becomes clogged, the raw sirup can be run onto the adjacent clean filter. This allows the first felt to drain and be cleaned. Using two or three of these units, filtration can be made into a continuous process.

Sirup filters best when it is hot, since when near its boiling temperature, its viscosity is very close to that of water. Therefore, it is desirable that the boiling sirup (217°-221° F.) be filtered immediately after being drawn from the evaporator. Also, the filtered sirup will remain hot enough (180° F. or above) to permit its being "hot packed."

Flat filters are easily cleaned of deposited sugar sand between uses. In the case of heavy deposits, the bulk of the sugar sand can be scraped from the filters and the felts washed in three successive portions of hot water. No soap or other detergent should be used. The felts can be put through a wringer, providing that only a small amount of tension is put on the rollers, and then be hung to dry.

There still remains, however, several objections to the use of wool felt filters. They are susceptible to shrinkage, which is particularly objectionable when they have been cut to size for use as flat filters. They also have a tendency to become discolored by the sirup, making it difficult to determine whether or not they are thoroughly cleaned by the washing. More important, they frequently impart a detectable "off" flavor to the first two or three lots of sirup filtered through them. This "off" flavor is not removed even by several washings of the new felt prior to use, and disappears only after several lots of sirup have been passed through the filter. This flavor-imparting characteristic may be attributed to the intrinsic properties of the wool fiber or to properties imparted to them as a result of the drastic chemical treatments involved in the manufacture of wool felt. In addition, wool felt, during storage between maple seasons, is subject to mold and moth damage unless proper preventive measures are taken.

The possibility of overcoming these objectionable features of wool felt was investigated. Felts of synthetic fibers, of approximately the same thickness and fiber characteristics as wool, are now available commercially.

These felts were first tested in the laboratory and found to warrant further testing under commercial sirup-producing conditions. These trials were made during the 1959 maple sap season.

Under commercial conditions an orlon felt was found to yield highly polished sirups even when they contained finely suspended sugar sand and they imparted no undesirable "off" flavors to the sirups, even in the first lots filtered. Water and heat did not weaken the felt or cause it to shrink. The sirups did not permanently stain the fibers, and they returned to their original white color on washing. No precautions are necessary to protect the synthetic felt from moth or mold damage.

The number of gallons of sirup which can be filtered through a given flat synthetic felt filter is, as is the case with wool felt filters, increased by use of a prefilter.

Recently a modification in the processing of sap into sirup, which permits better filtering practices, is being adopted by the maple industry. This consists of evaporating the sap to sirup in two stages. In the first stage, the sap is concentrated to a density of 50°-60° Brix in the conventional flue type evaporator. The nearly finished sirup is then transferred to a separate "finishing" pan where it is concentrated "batchwise" to standard density (65.5°-67° Brix). With this modification, the sirup can be filtered in two steps, the first filtration occurring when the "sirup" is transferred from the flue evaporator to the "finishing" pan. The second filtration occurs as the standard density sirup is withdrawn from the "finishing" pan. The hot "sirup" during the first filtration is of low density and contains the bulk of the insoluble sugar sand. While a prefilter is desirable for this first step filtration, its use can be omitted because of the rapid flow rate of this hot, thin "sirup" through the felt. Since most of the sugar sand is removed by the first filtration and only a little more is formed during the last stage of the evaporation in the "finishing" pan, only a relatively small amount of sugar sand is present in, and has to be removed from, the more viscous finished sirup. Due to the small amount of sugar sand to be removed by the second stage of filtration, a relatively large volume of sirup can be filtered through a single synthetic felt before it is clogged and has to be replaced. The small amount of sugar sand at this second stage of filtration does not make the use of a prefilter as essential as it was for the first stage of filtration.

Other synthetic felts such as nylon, dynel, etc. are being investigated for use in the filtration of maple sirup.

Mention of trade names does not imply endorsement of these products by the U. S. Department of Agriculture over other products.